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The Contribution of Traditional Meat Goat Farming Systems to Human Wellbeing and Its Importance for the Sustainability of This Livestock Subsector

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Abstract: Traditional meat goat farming systems are characterized by rearing autochthonous breeds and using natural resources through grazing, often within protected natural areas. In a context of reduction of the number of farms, due to the low income derived from the sale of kids, the role of those systems as suppliers of presently non-remunerated ecosystem services becomes more relevant. The objective of this article is to analyze the current situation of those systems, focusing on their connection with human wellbeing, and to formulate proposals that can contribute to guaranteeing their profitability and continuity. A technical-economic and environmental study of a sample of farms and an analysis of the limiting factors affecting the subsector were carried out. As a result, a set of multifactorial problems was identified, with the lack of acknowledgement and remuneration of some services—mainly environmental and cultural—provided by those systems and the low selling price of kids standing as the main threats. The consideration of meat goat farms as "producers of meat of high functional quality and providers of ecosystem services", which should be properly quantified and remunerated, would contribute to their preservation and guarantee the provision of benefits associated with the activity.

Keywords: autochthonous goat breeds; ecosystem services; pastoralism; Natura 2000 network; profitability; carbon footprint

1. Introduction

The main objective of any civilization or form of government should be to achieve and secure people's welfare—the essential components of which are: Access to material wellbeing; health, social relationships; security; and freedom of choice and action [1]. Achievement of this objective is contingent on the availability and quality of the social capital, technology, and institutions of that society—but also, and very intimately, on the services provided by its ecosystems [2]. The former are easily identified, but this is not the case with the latter, which are usually disregarded, especially in economically developed societies, despite the fact that the whole system is built upon nature. On the one hand, ecosystems are the source of all the materials and energy that are processed and transformed into consumption goods and services. On the other, they are the sink for all the waste generated by economic activities [3]. Therefore, ecosystems may be analyzed from an economic-ecological perspective as natural capital, a term that was coined in the 1990s and represents the goods and services provided by ecosystems that help improve people's quality of life [4]. Understanding ecosystems as natural capital, Gómez-Baggethun and De Groot [3] define the "products of their structure and functioning that have a potential or real incidence on human wellbeing" as ecosystem functions and services. Functions are elements that are potentially capable of generating services that contribute to the improvement of people's quality of life. Services are specific benefits with a real impact on the citizens.

According to De Groot et al. [5], mainstreamed by the Millennium Ecosystem Assessment, ecosystem services (ES) are classified into four categories: Provisioning, regulating, supporting, and cultural. Provisioning services are products directly obtained from the ecosystems (for instance, food, fresh water, wood, cellulose or genetic resources). Regulating services are benefits indirectly obtained from ecosystem processes (for instance, climate regulation, flood control or water purification). Cultural services are immaterial and intangible contributions made by the ecosystems to human experience (for instance, spirituality, recreation and tourism, esthetic enjoyment, education, sense of identity or cultural heritage). Supporting services category has been questioned because it could lead to double counting since its value is reflected in the other three types of services.

The various contributions of the ecosystems to human wellbeing are not adequately acknowledged or valued; consequently, they are not considered in commercial circuits or political decision-making processes [6]. This fact is an enormous competitive disadvantage for those activities that create frameworks—in this specific case, agroecosystems—favoring the provision of beneficial services to people. These services are neither remunerated in the market or via policies, nor included in the cost structure of other less sustainable activities.

In the last decades, the disappearance of many pastoral uses of the territory has revealed the importance of sustainable livestock management for environmental conservation. The abandonment or progressive decline of pastoralism has had negative consequences for biodiversity and ES, especially in marginal areas traditionally used for that activity [7]. In many ecosystems, with a deep-rooted grazing tradition, the complete exclusion of livestock rearing has brought about changes in the richness and diversity of species, favoring an increase of woody vegetation, and consequently, biomass fuel [8–10]. In addition, the abandonment of livestock farming has led to the modification of certain interspecies interactions (affecting, for instance, pollinators, herbivorous insects, parasitoids, etc.) [8, 11–13]. In this sense, a recent report of the European Commission pointed to the decline of traditional grazing activities as one of the main threats, in large areas of Europe, to the objectives of the Natura 2000 network concerning the conservation of agricultural habitats [14]. There is an increasing number of studies showing that good management practices in livestock husbandry are key for the resilience, sustainability and preservation of biodiversity in pastoral ecosystems, especially in rural and mountain areas, where goat production plays a relevant role.

Goat husbandry has had its own evolution in this period. This livestock subsector did not participate in the first great revolution in European agriculture and livestock farming, which took place in the 19th century. During this period, agricultural activities were intensified in order to meet the demands of the growing urban population. Milk and dairy products were mainly supplied by dairy cow farms, while the goat sector remained active in marginal and usually poorer areas [15]. In these regions, many of which (including Andalusia) were located in the Mediterranean basin, where arable land is quite limited, food derived from livestock production was very important [16]. Goat rearing, based on grazing and the use of natural resources, was essentially limited to the production of one 30-40 kg kid, as well as cheese for self-consumption [17].

From the 1980s onwards, interest in the production of goat milk increased, especially in developed countries, such as France and Spain. However, a series of socioeconomic and legislative changes took place following Spain's and other Mediterranean countries entry into the European Common Market, in order to adapt to the European framework. In fact, the strict European legislation on food quality and food security issues and the concern of obtaining growing volumes of milk per farm led to the intensification of production and the decline of grazing livestock systems [17]. As a result, despite the fact that pastoral goat husbandry is nowadays the main feasible economic and productive activity in Mediterranean mountain areas of Spain and elsewhere, where the climatic and soil conditions hinder the development of other agricultural and/or livestock-rearing activities, the above-mentioned process of milk specialization has progressively broken the link between this sector and the territory where it is based. For example, the findings of Mena et al. [18], indicated that, in the 1990s, most of the goat farming systems in central-western Andalusia were highly extensive, but Castel et al. [19] affirmed that in 2010 up to 47% of the farms were intensively or semi-intensively managed. On the other hand, Pulina et al. [20] have revealed that the grazing livestock population in Spain has dropped by almost 50% in the last 25 years.

One part, albeit small, of the goat-rearing sector in Andalusia has not undergone the milk specialization or management intensification processes. This part is represented by the traditional meat-producing systems, based on the use of very rustic endangered breeds that are less apt for milking than the rest of the autochthonous Andalusian breeds. Among these breeds, the Blanca Serrana Andaluza or Serrana (hereinafter Blanca Serrana), the Negra Serrana or Castiza (hereinafter, Negra Serrana), and to a lesser extent, the Blanca Celtibérica deserve to be highlighted [17]. In Andalusia, most meat goat farms are located in areas that belong to the Andalusian Network of Protected Natural Areas, mainly in the sierras of Jaen, Granada and Huelva. Many of them are managed following a certified organic production model.

These goat farms are faced with a serious problem concerning the commercialization of its main product: The kid, which has to compete in the market with kids from dairy goat breeds. The total per capita consumption of fresh meat in Spain amounted to 33.8 kg in 2018 [21]. However, domestic consumption of fresh sheep and goat meat (which are combined in the statistics) is still the sector's primary challenge. This segment has performed quite poorly in recent years. In 2008, the per capita consumption reached 3.4 kg, but ten years later, in 2018, it had dropped to 1.36 kg. As regards kid meat, the estimated per capita consumption is 0.3–0.5 kg. Lamb/kid meat is considered expensive (6.8 on a 0 to 10 scale), and is mostly consumed on family gatherings at special occasions [22]. Suckling kid meat is the preferred goat carcass in Spain; it originates from animals fed only on milk and slaughtered aged 35–45 days at 8-10 kg live weight [23–25].

In contrast to the loss of importance as meat suppliers, pastoral meat-oriented goat farms are considered important providers of "environmental services". However, this has rarely been the object of study by the scientific community. The literature devoted to describing the activity, analyzing its contribution to the conservation and management of the territory, identifying its challenges, and proposing specific actions, is very limited. The low selling price of kids and the lack of remuneration of other ecosystem services has resulted in a lack of profitability, and in the progressive reduction of the number of livestock farms implementing traditional meat production models. In addition, there are other complex and multifactorial problems contributing to the disappearance of this livestock subsector. In brief, the main objective of this work is to analyze the general situation of traditional meat goat systems in Andalusia, focusing on their relationship with human wellbeing, and to define proposals that can contribute to guaranteeing profitability and continuity. For the achievement of this general objective, the article suggests to fill the existing void of information through: (i) The description of the subsector, including the identification of the main environmental services provided by it; (ii) the analysis and hierarchization of the factors limiting the activity; and (iii) the proposal of specific actions aimed at obtaining the acknowledgement of these breeds as "environmental".

2. Materials and Methods

2.1. Study Area and Breeds

Andalusia, the southernmost autonomous region in Spain (36ºN-38º44′N and 3º50′W-0º34′E), covers an area of 87,600 km^2 and is structured around four geomorphological units: The Guadalquivir river valley; the coast; Sierra Morena-Los Pedroches; and the Baetic mountains and valleys [26]. The Baetic depression has fertile soils and is characterized by its high agricultural production. The mountains comprise a heterogeneous system with different states of ecological maturity and grazing as its main economic activity. Andalusia has a population of 8.4 million, 23%

of which is considered rural. This percentage, which is higher than the national average of 16%, has significantly decreased during the last decade [27].

Up to 32% of the Andalusian area (2,670 km^2) belongs to the Natura 2000 network (European Habitats Directive, Council Directive 92/43/EEC) and includes 243 protected areas (Figure 1), which are the outcome of an intricate relationship between social and ecological systems [28]. Many of those protected areas are located in mountain and difficult access areas, which are the natural habitat of the goat breeds studied in this work. The Negra Serrana breed is exclusively found in the province of Jaen, particularly within the Sierras de Cazorla, Segura y Las Villas Natural Park. The Blanca Serrana breed is distributed throughout Andalusia, but lives preferably in mountain areas [29]. Thus, it is found in the Dehesa de Sierra Morena Biosphere Reserve, the Sierras de Cazorla, Segura y Las Villas Natural Park, and in neighboring areas of the province of Granada, such as, for instance, the Sierra de Castril Natural Park (Figure 1).

The Sierras de Cazorla, Segura y Las Villas Natural Park (province of Jaen, southeastern Spain) is characterized by its great extension (2,143 km^2) and a wide variety of landscapes: River valleys and meadows, mid-mountain areas, high plateaus and high mountain areas [30]. Extension and diversity also condition the climatic variability within the park and its high rainfall levels, which are among the highest in the south of the Iberian Peninsula. It is the second natural park in Europe in terms of plant biodiversity, being the home of 35 endemic species and 110 exclusively Andalusian species [31]. The tree story is mostly made up of pinewood (*Pinus nigra*), but there are relics of Mediterranean forest and formations of singular deciduous species (*Corylus avellana*, *Quercus faginea*, *Q. rotundifolia* and *Q. pyrenaica*). Plant communities are generally dominated by sclerophyllous woody plants with an herbaceous or shrubby understory [32], the exploitation of which is especially important to maintain goat farming.

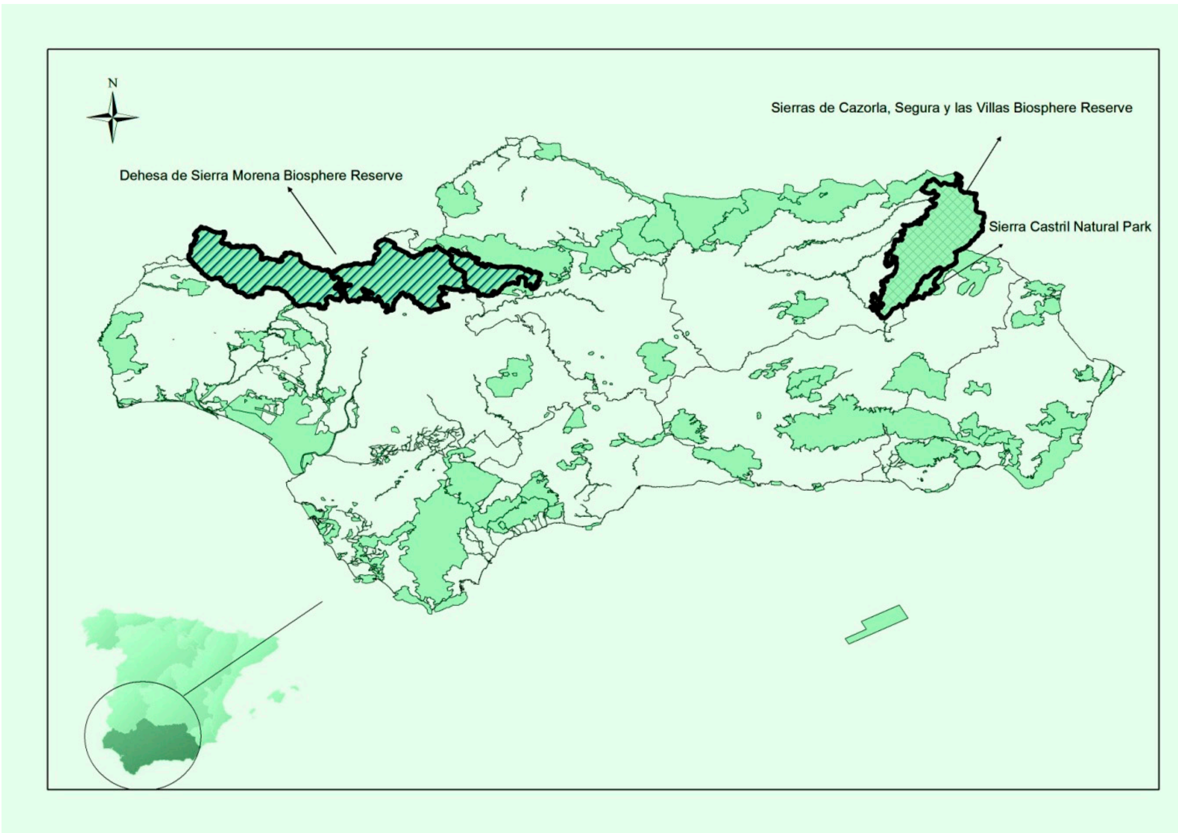

Figure 1. Natura 2000 network (dark areas) and distribution of the area of study (highlighted with lines**)** in Andalusia (Spain).

The Dehesas de Sierra Morena Biosphere Reserve (4,244 km^2) (southwestern Spain) comprises the Aracena and Picos de Aroche Natural Park (in the province of Huelva), the Sierra Norte Natural Park (in the province of Seville), and the Sierra de Hornachuelos Natural Park (in the province of

Córdoba). The most representative and common landscape of the reserve is the dehesa, a unique model of sustainable development and an example of popular wisdom, which over the centuries has provided access to multiple natural resource uses—combining in a harmonious and balanced way agricultural uses with stockbreeding, hunting and forestry [33]. The reserve includes large areas of chestnut forests (Castanea sativa) and cork oak forests (Q. ilex and Q. suber), surrounded by pastures, meadows and Mediterranean scrub, creating an exceptional mosaic of landscapes [34, 35]. These landscapes contain very high biodiversity, including some of the most emblematic species of the Mediterranean ecosystems, such as the Iberian Lynx, the Spanish Imperial Eagle, or the Eurasian Black Vulture [36,37].

The current Andalusian population of the Negra Serrana breed is 814 animals (46.6% of the total population in Spain), according to the herd-book. They are distributed among seven farms (all of them within the province of Jaen), with average flocks of 117 goats. As regards the Blanca Serrana breed, its population in Andalusia is estimated at 7176 goats (93% of the total national population), distributed among 38 farms with average flocks of 176 animals [29].

2.2. Technical-Economic Characterization of the Monitored Farms and Calculation of the Carbon Footprint

From the above-mentioned 45 meat goat farms based in Andalusia (Negra Serrana and Blanca Serrana breeds), a sample of five (10% of the total farms) was selected: Three of them rearing the Blanca Serrana breed and the other two rearing Negra Serrana flocks. The selection of those farms was made according to the following criteria: (i) Representativeness of the production model, management practices and variety of ecosystems; (ii) data gathering and registration routine; (iii) training of the farm's manager; and (iv) good disposition and collaborative spirit.

According to the authors' previous experience [38–40], the farms selected were monitored monthly during 2018 in order to collect technical-economic and environmental information, as well as to calculate relevant indicators. Among the indicators, the following two deserve highlighting: (i) Net margin: Incomes for market plus coupled aid minus Total cost excluding family labor cost; and (ii) Net Economic Margin: Net margin minus family labor cost. For their estimation, neither the income from decoupled aid nor the differences in the inventory of the current stock were taken into account.

The carbon footprint was determined in the way described by Gutiérrez-Peña et al. [40]. For the calculation of greenhouse gas (GHG) emissions, the scope of the study was defined as "from cradle to gate", and all the emissions produced at the farm, including livestock emissions, managed soil emissions, etc., were considered. The emissions associated with the manufacturing and transportation of every input of the system (fertilizers, feed, etc.) were also taken into account. Machinery, buildings, medicines and other minor stable supplies were excluded from the assessment. The IPCC [41] guidelines have been followed. The emissions are expressed in CO_2 equivalents calculated using the IPCC 100-year global warming potentials (GWP) for CH_4 and N_2O, which are, respectively, 25 and 298. In addition to GHG emissions, the carbon sequestration by the vegetation of pastoral ecosystems was calculated with the methodology developed by Petersen et al. [42], which takes into account a 100-year perspective to allocate soil C changes, as well as the GWP of the livestock emissions. The values have been calculated for two different functional units: (i) One kilogram of live weight at slaughter (LWS) for kid goats; and (ii) 1 ha of usable land for grazing (ULG) at the goat farm [40]. The principles of allocation applied were economic, based on the sale of kids of around one month of age and 10 kg live weight. No other income sources were evident within the scope of the study (animals and manure sale), and the allocation of the carbon footprint to meat varied by farm and year from 88% to 100%, with an average of 97%.

For the technical-economic and carbon footprint variables, descriptive statistics (mean, minimum and maximum values*)* were determined using SPSS software for Windows (version 26.0, IBM Corp., Armonk, New York, USA).

2.3. Structural Analysis of the Problems Affecting the Meat-Oriented Goat Subsector

For the purpose of developing a problem resolution methodology in an orderly and efficient manner, a structural analysis of a set of factors limiting the activity has been carried out following the proposal elaborated by Godet [43] and adapted by Mojica [44]. Structural analysis is a tool designed to structure collective reflection. It offers the possibility of describing a system with the help of a matrix that relates all the problems (hereinafter referred to as variables) to each other. Based on that description, the method aims at revealing the main influential and dependent variables, i.e., those that are essential to the evolution of the system. According to Godet [45], the analytical method is divided into the following phases: (i) Elaboration of a list of variables; (ii) description of the relationship between variables; and (iii) identification of the key variables. The implementation and development of those phases in relation to the present work are described below:

i) In order to identify the variables, a focus group was conducted in Cordoba (Spain) as part of a training workshop organized by ABLANSE (National Association of Blanca Serrana Goat Breeders) under the title "Analysis of the Evolution of Breeds and Future Prospects". A round table and a group dynamic were included in the program and joined by a small group of people (20): Academic staff of the University of Seville and the University of Cordoba, as well as technicians and farmers belonging to ABLANSE and ANCCA (National Association of Negra Serrana Castiza Goat Breeders). The discussion focused on the identification and analysis of the factors limiting meat goat husbandry and conditioning its continuity. A selection of the factors considered to be most relevant was then made. In parallel, consultations were held with expert operators within the subsector.

ii) For the description of the relationship between the different variables, the direct effects that some of them have on others were identified. Treating each variable independently, they were all confronted with the rest. If an influence was observed, the variable was assigned the value 1; otherwise, it was assigned the value 0. Thus, a binary table was created where the variables were confronted, and the scoring was registered.

iii) Finally, the key variables of the system were identified through the calculation of the motricity index (MI, indicating the number of times one variable has influenced the others), and the dependence index (DI, indicating the number of times one variable has been affected by the others). These key variables were grouped into four areas or types of problems (Power, Conflict, Exit and Independence). Later on, a chart was designed to show the distribution of the variables on the plane. The chart was divided into four zones limited by the average value, calculated using the 100/n formula, n = 25 being the number of variables considered. Each quadrant corresponded to a type of problem or limiting factor:

- Power Zone: This zone comprises factors that have an influence on the rest, but are not affected by them. They are hardly vulnerable, but their resolution would have a positive impact on the whole system (MI > 4% > DI).
- Conflict Zone: The problems included herein have an influence on the others, but are also very dependent on them. They are influential, as well as vulnerable. As stated by Mojica (44), any variation in these factors would have a great impact on the exit problems, but also on themselves (MI > 4% < DI).
- Exit Zone: The problems in this zone will only be reduced or solved if actions are taken in relation to the two previous categories. They are the outcome of those two groups, and are therefore, dependent on them (MI < 4% < DI).
- Independence Zone: These are autonomous factors that are not clearly part of the system. They have very little influence or dependence on the rest. Their resolution may be important, but will have no effect on the system (MI < 4% > DI).

Once this classification was made, the key variables (hierarchized limiting factors) that need to be analyzed for the development of action plans were identified.

3. Results

3.1. Technical-Economic and Environmental Analysis of the Sample of Farms

Table 1 reflects the general characteristics of the farms analyzed. The size of the flocks varies by farm: In two of the farms, it is below the average set by the corresponding association of breeders (117 goats for the Blanca Serrana breed, and 176 goats for the Negra Serrana breed), while in the remaining three it is above that average. The amount of work associated with the activity is small and established for these five farms at an average of 0.43 annual work units (AWU), which, if expressed in the number of goats, corresponds to 546/AWU. It is important to underline that there are no women working on these farms and that most of the labor is provided by the family (69.3%), while hired labor is mainly used temporarily during the kidding season.

Table 1. General characteristics of the monitored farms.

Item	Mean	Minimum	Maximum
Goats (No.)	217	118	366
Area used by the goats (ha)	285.4	51.0	630.0
[1] Goat stocking density (LSU ha^{-1})	0.25	0.09	0.78
[2] Work associated with the activity (AWU)	0.43	0.15	0.67
Kids born $goat^{-1}$	0.86	0.66	1.07

[1] LSU: Livestock standard unit, one goat equals 0.15 LSU; [2] AWU: Annual work unit.

Livestock density is low (0.25 LSU ha^{-1}), and the presence of other species on the farm is frequent, mainly sheep and cattle, sometimes also pigs. In these systems, the main source of feed is grazing. The area of natural vegetation is large, with an average of 1.29 ha $goat^{-1}$, most of which are covered by shrub pasture (52%) (Figure 2). The surfaces devoted to crops destined to feed the goats are small. Oats and vetch or clover are usually grown in those areas, as a supplement for the summer, when the availability of natural resources is limited. Two of the monitored farms do not have such areas, and the other three only grow crops to be grazed, rather than to produce grains or fodder to be consumed indoors. The goats graze the natural resources, especially those in the shrubby understory, under extensive conditions and throughout the year. In the forest story, the presence of oaks (*Quercus ilex L.*) is to be highlighted, while the shrubby understory, which is the most important one, consists of a wide range of species (rockrose, mastic tree, myrtle, narrow-leaved mock privet, etc.). In order to facilitate the monitoring and avoid the damage caused by predators, the goats have their grazing limited a few days before kidding and during the lactation period. Consequently, during this period, the goats receive a supplement of concentrates, compound feed, and/or fodder of varying quality.

The sale of kids is the main, and in many cases, the only market income of meat-oriented pastoral goat farms. These kids are aged 35–45 days and their maximum average weight is 10 kg live weight. Despite their importance in the results account, the average number of kids born per doe is low (0.86, Table 1), while the average number of kids sold per doe present on the farm is even lower, 0.62.

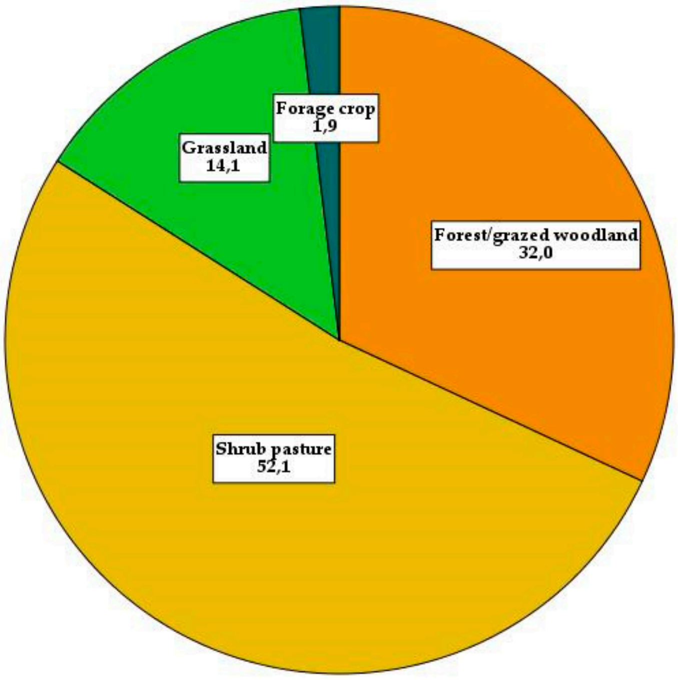

Figure 2. Distribution of the area devoted to feeding the goats (%).

Table 2 shows the main economic indicators of goat farming. Despite the fact that these farms are raising pure-breed animals registered in the corresponding herd-book, the sale of animals for further rearing is important for only two of the monitored farms, and not at all for another three. On average, during 2018, the income per goat and year earned from the sale of live animals for replacement was only 7.4 euros. If the aid is excluded, the remaining amount is considered residual income (Table 2).

The percentage of income derived from aid varies from 23% to 69% of the total: It shows the high dependence of these farms on EU aid (Table 2). These incomes come mainly from: (i) The Basic Payment Scheme (decoupled payment from the First Pillar of the Common Agricultural Policy, CAP); (ii) aid to livestock farming in mountain areas (coupled payment from the First Pillar of the CAP); (iii) maintenance of endangered pure autochthonous breeds (measure 10.1.2 of the Rural Development Program, RDP, of Andalusia); (iv) maintenance of ecological agriculture and husbandry practices and methods (measure 11.2.1 of the Andalusian RDP); and (v) aid to areas with natural or other specific constraints (measure 13 of the Andalusian RDP). In addition, one of the farms receives a subsidy from the provincial administration of Jaen. Table 2 differentiates between revenue from coupled and decoupled aid.

Within the cost structure, the little relative importance of feed expenditure, which includes purchased feed and crops, is to be noticed (Table 2). The average is 25.2%, although the variability among the five farms analyzed is high. The expenses associated with health treatments and energy are low, as is the cost of amortization. The few infrastructures required and the low level of investment in the activity explain this fact.

The main economic indicators of the activity are also included in Table 2. It is to be highlighted that, for their estimation, neither the income from decoupled aid nor the differences in the inventory of the current stock were taken into account. Except on one farm, the indicator "Net Economic Margin" is negative.

Table 2. Main economic indicators of the monitored farms.

Item	Euros Goat^{-1}			Euros ha^{-1}		
	Mean	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Income from the activity						
Sale of goat kids	25.44	9.60	37.20	38.36	7.50	125.49
Sale of animals for further rearing	7.40	0.00	29.80	5.62	0.00	23.33
Other income	2.94	0.00	6.60	3.82	0.00	9.80
Total market income	35.78	30.80	42.30	47.82	20.19	135.29
Income from coupled aid	26.89	12.49	41.94	39.86	6.92	120.39
Income from market+ coupled aid	62.67	54.80	81.34	87,68	30.30	255.70
Income from decoupled aid	18.39	0.00	44.06	35.07	0.00	129.39
Total income (market + aid)	81.06	54.80	125.80	122.75	30.28	385.09
Cost of the activity						
Feed (purchased + crops)	18.96	0.00	38.40	25.28	0.00	64.41
Health	2.00	0.80	4.70	4.95	0.46	20.70
Energy	5.38	0.00	9.80	7.98	0.00	23.53
Hired labor	13.04	0.00	32.80	9.81	0.00	30.55
Other costs	16.28	4.90	46.10	21.29	4.44	55.90
Family labor	19.02	4.20	34.50	33.57	2.43	120.47
Amortization	0.64	0.00	2.00	1.91	0.00	8.82
Total costs	75.32	44.30	101.70	104.79	24.53	293.84
Economic indicators						
[1] Net margin	6,37	−27.40	34.30	16.46	−25.52	81.74
[2] Net Economic Margin	−12,65	−32.50	10.50	−17.11	−39.05	5.81

[1] Net Margin**:** (Income form market + Income from coupled aid)—(Total cost - Family labor cost); [2] Net Economic Margin**:** Net margin—Family labor cost. For their estimation, neither the income from decoupled aid nor the differences in the inventory of the current stock were taken into account.

As for the calculation of the carbon footprint, total emissions are shown in Table 3, and the contribution per polluting source is also available.

Table 3. Contribution to the carbon footprint from different sources and annual carbon I sequestration of the monitored farms.

Item	[1] kg CO_2-eq kg LWS^{-1}			[1] kg CO_2-eq ha ULG^{-1}		
	Mean	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Total emissions	**52.9**	**23.7**	**102.1**	**359.7**	**108.3**	**979.7**
Livestock emissions	33.3	18.7	68.6	235.6	85.3	676.5
Soil emissions	8.8	4.9	18.8	62.4	21.4	181.2
Input emissions	10.7	0.1	23.2	61.7	0.49	121.9
Total C sequestration	**23.7**	**9.1**	**42.4**	**139.5**	**30.89**	**318.6**
By vegetation	18.1	4.7	37.9	90.4	22.8	163.9
By manure	5.6	4.4	6.7	49.1	8.1	154.7
Carbon footprint	**29.2**	**-3.54**	**72.9**	**220.2**	**32.9**	**746.3**

[1] Calculations have been made with two different functional units: (i) One kilogram of live weight at slaughter (LWS) for kid goats; and (ii) 1 ha of usable land for grazing (ULG).

The main source of GHG emissions on the farms studied is the animals' metabolic activity (mainly due to enteric fermentation), which accounts for 65% of the total; the rest are input (18%) and soil emissions (17%) (Figure 3). The results of this study show that the inclusion of carbon sequestration by vegetation reduced the total GHG emissions of these pastoral farms by 38%-45%, depending on the functional unit used (Table 3). The mean carbon footprint of the farms analyzed ranged from 23.7 to 220.2 kg CO_2-eq, depending on the functional unit used, and was negative in one of the farms (Table 3).

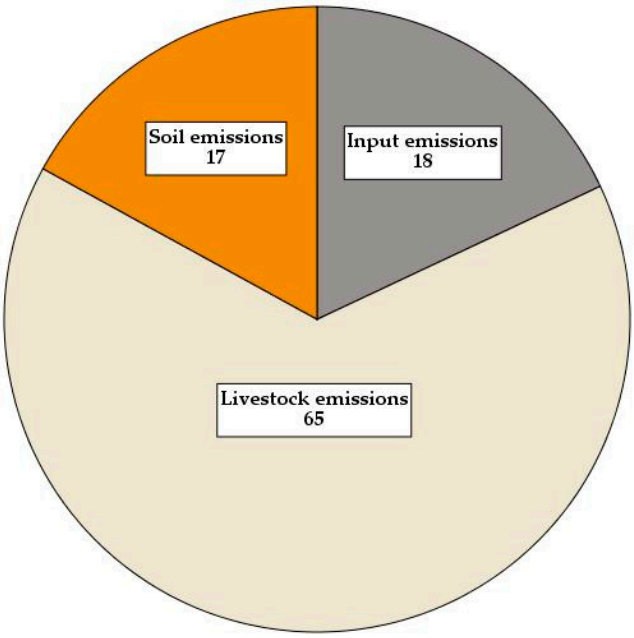

Figure 3. Contribution to total emissions (%) from different sources.

3.2. Structural Analysis of the Problems Affecting the Activity

During the development of the focus group, a total of 41 variables or limiting factors affecting the activity were identified. These were assigned a score between 0 (no importance) and 3 (very important), and a final selection of 25 factors was made to be used for the structural analysis (Table 4). The low selling price of kids was the variable that received the highest score, while the lack of research applied to the industry received the lowest. From the 25 variables, 28% were grouped in the power zone, 24% in the conflict zone, 28% in the exit zone, and 20% in the independence zone (Table 4).

Figure 4 represents the motricity and dependence index scores obtained for each variable. As suggested by Mojica [44] and Godet [43,45], the natural sequence of action would be to address, first of all, the problems located in the power zone, and subsequently, those in the conflict zone. Among the problems identified within the power zone, two are intimately linked to the lack of acknowledgement of the ecosystem services provided by the sector: (i) Little knowledge of or regard for its environmental services; and (ii) little knowledge of or regard for its socioeconomic and cultural contributions. The limited knowledge of the differential characteristics of grazing goat kid meat, a factor related to the provision of supply services, is placed in the conflict zone. It is also interesting to underline the importance, within the power zone, of the inadequate design of CAP aids, which may be directly connected with the ineffectiveness of public aid when it comes to guaranteeing the viability of this activity.

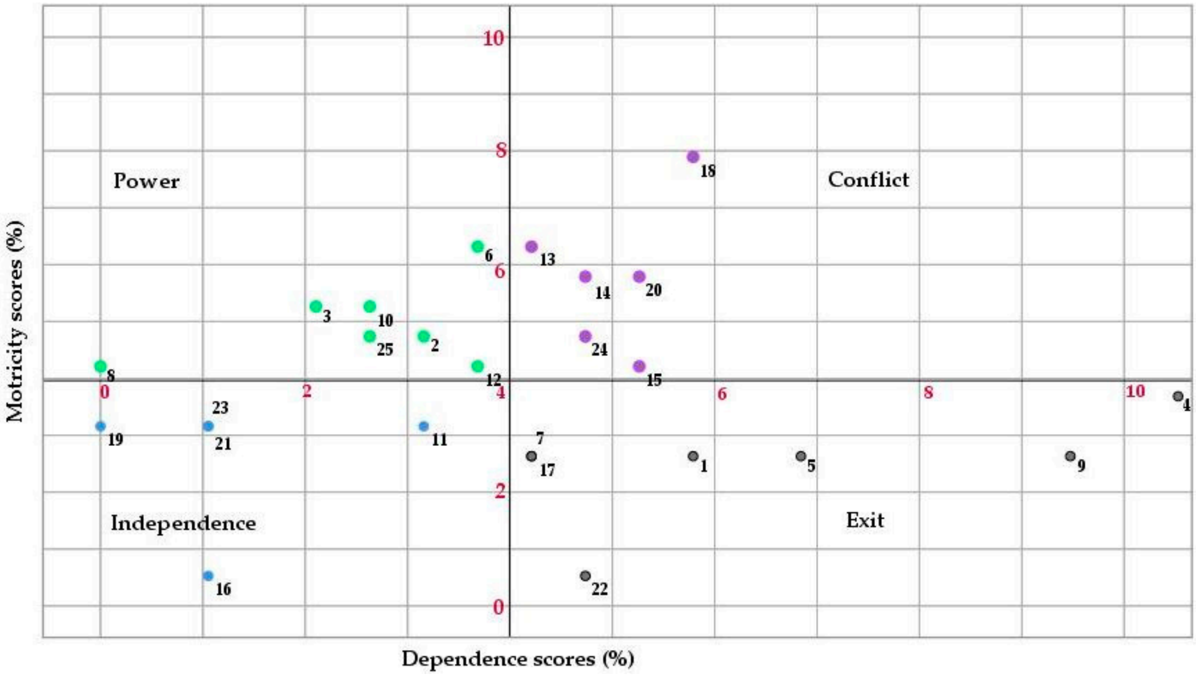

Figure 4. Graphic representation of the structural analysis of the problems/limiting factors listed in Table 4. Motricity (y-axis): Higher values indicate greater influence; Dependence (x-axis): Higher values indicate greater dependence.

Table 4. Selection of problems/limiting factors, score obtained, and classification according to the structural analysis.

Number	Limiting Factors/Problems	Score	[1] Location Zone
1	Low selling price of kids	3.00	Exit
2	Inadequate design of CAP aids	3.00	Power
3	Little knowledge of or regard for the environmental services provided by the meat-oriented goat subsector	3.00	Power
4	Lack of generational renewal in farming families	2.83	Exit
5	Little professional and social acknowledgement of the activity	2.83	Exit
6	Little knowledge of or regard for the socioeconomic and cultural contributions of the meat-oriented goat subsector	2.83	Power
7	Lack of regularity and delays in the reception of aid	2.67	Exit
8	Presence of suckling kids from dairy farms conditioning the market	2.50	Power
9	High average age of farmers	2.50	Exit
10	Bureaucracy and relationship with the corresponding administrations	2.50	Power
11	Excessive or complicated specific demands associated with the location of the farms in protected areas	2.40	Independence
12	Current preferences of kid meat consumers	2.33	Power
13	Disappearance of local slaughter and skinning facilities	2.33	Conflict
14	Little knowledge of or regard for the differential characteristics of grazing goat kid meat	2.33	Conflict
15	Limited availability of the product in local catering businesses	2.17	Conflict
16	Difficulty in finding skilled labor	2.17	Independence
17	Difficulty in meeting agri-environmental commitments, and consequent economic reductions	2.17	Exit
18	Lack of joint marketing initiatives	2.00	Conflict
19	Geographic dispersion of the farms hindering the development of joint marketing initiatives	2.00	Independence
20	Limited availability of the product in the distribution channels	2.00	Conflict
21	Excessive seasonality of kid prices	1.83	Independence
22	Limited market for goat meat and/or low value of the product	1.83	Exit
23	Lack of adaptation of the sanitary norms and requirements to pastoralism	1.83	Independence
24	Difficulties in carrying out the activities of the associations of breeders	1.83	Conflict
25	Lack of research applied to meat-oriented goat subsector	1.83	Power

[1] Power: Factors that have an influence on the rest, but are not affected by them (MI > 4% > DI); Conflict: Problems that have an influence on the rest, but are also very dependent on them (MI > 4% < DI); Exit: Problems that will only be solved if actions are taken in relation to the two previous categories (MI < 4% < DI); Independence: autonomous factors that are not clearly part of the system. They have very little influence or dependence on the rest (MI < 4% > DI).

4. Discussion

4.1. Pastoral Goat Farming as Provider of Ecosystem Services

In addition to food, agro-forest-pastoral systems with the presence of goats can provide a wide range of benefits and services to society. However, as argued by Cooper et al. [46], given that those services have no market price, farmers have little or no incentive to produce them, regardless of the high societal demand. Rodríguez-Ortega et al. [47] and Cooper et al. [46] identified five of those ecosystem services (ES) among the most relevant non-market functions of European agriculture: Maintenance of sustainable agricultural landscape, biodiversity conservation, forest wildfire prevention, regulation of climate change through carbon sequestration, and production of local quality products.

4.1.1. Provisioning Services

The results of our study show that 71% of the market income of the farms analyzed comes from the sale of kids for slaughter. This service is virtually the only remunerated one among those supplied by the farms, but it is insufficient to guarantee the profitability of the activity. This is mainly due to three causes: (i) The low productivity per animal; (ii) the current marketing model, focused on the commercialization of undifferentiated suckling kids; and (iii) the low selling price of kids during most of the year, which does not cover the costs of production. In Greece, Hadjigeorgiou et al. [48] found values for kids produced by goat and year ranging between 0.89 and 1.09, i.e., higher than those obtained in the five farms monitored in this study (0.86). In 2007, Luque [49] found, for a sample of 57 extensive goat farms in Castilla La Mancha and Andalusia (Spain), that the number of kids sold per doe reached 1.19, a much higher value than that of 0.62 established in this work.

In Spain, the market preference is for suckling kids, rather than larger animals. In 2018, 1.06 million suckling kids with an average weight of 5.17 kg carcass $^{-1}$ were slaughtered, in contrast with only 67,410 larger kids weighing an average of 12.98 kg carcass $^{-1}$ [50]. The sale of kids at 9.7 kg live weight, which is the average of the farms studied, hinders the creation of the value added, associated with raising a larger kid, as well as the development of the differential characteristics, mainly functional quality and organoleptic properties, that are typical of pasture-raised goat meat. The idea that the quality of a product needs to be taken into account in order to properly appreciate the value of an agricultural system for society is finding increasing support [51]. In this sense, kid meat is a first-rate provisioning ES, which contributes to people's wellbeing. According to the Spanish Database of Food Composition [52], the meat of suckling ruminants in Spain contains high protein, phosphorus, zinc and vitamins B_6 and B_{12}; it is also a source of potassium, selenium and vitamin B_3, and has a low content of sodium. Lately, there is an increasing demand for food that provides human health benefits through the presence of certain compounds, like fats. Unsaturated fatty acids (FA), such as n-3 FAs and conjugated linoleic acid (CLA), and fat-soluble antioxidants (e.g., α-tocopherol, carotenoids) are claimed to have benefits for human health [53,54]. In addition, some recommendations have been made on the basis of the n-6/n-3 polyunsaturated fatty acids (PUFA) ratio: An n-6/n-3 ratio of up to 4 is recommended in the human diet to help maintain good cardiovascular health [55]. The meat of Spanish autochthonous goat breeds reared in grazing-based production systems has a low content of fat and a healthier profile of FAs, especially in relation to the content of PUFAs and the n-6/n3 PUFA ratio [56–58]. Circumstantial evidence supports the hypothesis that phytochemical richness of herbivore diets that are high in plants (such as the farming systems studied in this work) enhances the biochemical richness of meat and dairy, which is linked with human health [59]. Among many roles they play in health, phytochemicals in herbivore diets protect meat and dairy from protein oxidation and lipid peroxidation that causes low-grade systemic inflammation implicated in heart disease and cancer in humans. However, future studies should elucidate how plant diversity influences biochemical richness of meat and dairy and how to affect the health of people [59].

The additional problem is that it is not easy for the consumer to identify and have access to differentiated pasture-based products. All this has an influence on the low selling price of the product and the little acknowledgement given to it by the consumers.

The experts who were consulted include the low selling price of kids as one of the three main problems affecting this sector, although this factor is located in the exit zone and its resolution would require previously addressing the problems within the power zone that are directly related to it: (i) Competition with suckling kids reared in dairy farms; (ii) the preferences of live goat kid purchasers; and (iii) the lack of knowledge of or regard for the healthier lipid profile of grazing goat kids, among other positive characteristics of this kind of meat.

Another ES supplied by goat husbandry is the preservation of animal genetic resources. Despite the fact that the five farms analyzed belong to the corresponding association of pure-bred breeders and that their animals are registered in the herd-book of each breed, the sale of live animals is a commercial option developed by only two of those farms, probably because the income derived from it is small (an average of 7.4 € goat $^{-1}$). There is nevertheless an enormous potential in it, so the sale of live animals should be increased, as an additional source of income on farms.

4.1.2. Regulating Services

Pastoral goat farming also plays an important role as a supplier of ecosystem regulation and maintenance services, in addition to provisioning ES. As described above, the goat breeds studied are mainly fed with natural resources, a management practice that decreases the number of external inputs and promotes closed systems in relation to energy and matter flows. These are completely extensive management systems where grazing is possible all year long, and in many cases, practiced on a transhumance basis, thus, enormously contributing to the management and maintenance of ecosystems with a high environmental value [8,60]. There is increasing scientific evidence that grazing in mountain areas is a key tool for the resilience, sustainability and conservation of biodiversity [61–64]. Through good practices in pastoral goat farming, appropriate management of the ecosystems is possible. These practices include: Control of accumulated biofuel, dispersion of Mediterranean species, decomposition of plant litter, the balance between native and invasive species, and preservation of the landscape [65,8,66,60].

Blanca Serrana and Negra Serrana goat flocks graze on wide extensions of Mediterranean mountain land, which are usually protected and would otherwise be exposed to abandonment. In addition to making good use of shrubby vegetation [67], the presence and activity of goats improve the access of other species to herbaceous pastures and increase the productivity of the latter. As stated by Osoro et al. [68] and Mena et al. [39], goats could easily complement the grazing activity of sheep and cattle in certain ecosystems where the shrubland is predominant, increasing the global productivity per hectare. This, linked to the fact that traditional meat-producing systems require less labor (which can, therefore, be employed in other activities), explains the abundance of multi-species farms. The farms monitored in this work have a ratio of 546 goats AWU $^{-1}$, in contrast with the 210 goats AWU $^{-1}$ of the dairy goat farms of the Sierra de Grazalema, in the province of Cádiz (Spain), found by Mena et al. [39].

Prevention of forest fires is a well-acknowledged regulating ES. Unfortunately, the frequency and intensity of forest fires in the Mediterranean basin are increasing and the interval between years of large wildfire events is shortening [67], a fact very much related to the abandonment of stockbreeding in those ecosystems. In recent years, there has been a shift in focus on long-term prevention policies: The processing of combustible biomass is now considered a key factor for their implementation. Preventive silviculture, and as part of it, supervised goat and sheep grazing are especially relevant tools [67].

Climate change, caused by an increment in the concentration of greenhouse gases (GHG), is another serious social concern. In this sense, the importance of evaluating farming systems in terms of GHG emissions has never been greater [51]. Pastoral goat husbandry is a production system that can positively contribute to the implementation of mitigation strategies, although some authors advocate the intensification of farming as the best solution, favoring specialized and more productive breeds rather than the rustic and traditional ones [69]. They argue that intensive systems have a smaller carbon footprint (CF), even though the evidence provided is partial because it only takes into consideration GHG emissions. When intensive and extensive stockbreeding are compared, carbon sequestration in ecosystems with the presence of livestock is generally disregarded. However, Batalla et al. [70] for sheep and Gutiérrez-Peña et al. [40] for goats have found that, when carbon sequestration is included in the estimation of the CF of extensive systems, the value obtained is similar to that of more intensive systems. Another element potentially distorting the results is that the CF is often calculated in relation to the output (number of kilograms produced), thus, significantly reducing the value in the most productive livestock farms. Finally, the deforestation resulting from the cultivation of crops for intensive livestock farms, located thousands of kilometers away, is not—although it should be—taken into account.

As grazing animals basically feed on forage, most GHG emissions come from the methane produced through enteric fermentation [71]. However, as observed in the farms studied, the emissions of CO_2 and N_2O are reduced to the minimum and represent, respectively, 18.4% and 16.9% of the total GHG emissions. Consequently, the GHG emissions per hectare are low (220.2 kg CO_2-eq ha^{-1}), in fact, substantially lower than those of the intensive grazing systems (8629.57 kg CO_2-eq ha^{-1}) analyzed by Gutiérrez-Peña et al. [40]. On the other hand, the value of the CF in the pastoral farms monitored in this work is, when expressed in emissions per kilogram of meat produced, distorted by the methodology employed for the calculation. In the case of farms that only sell kids, all the GHG emissions are allocated to the meat product, and given the above-mentioned low productivity rate, the value obtained is relatively high (52.9 kg CO_2-eq kg^{-1} LWS), compared to the 25.9 kg CO_2-eq kg^{-1} LWS for grazing lamb meat estimated by Ripoll-Bosch et al. [72]. No CF values have been found in the scientific literature for meat goat livestock.

Therefore, in order to obtain results that are closer to the reality of extensive meat goat farming, it is necessary: (i) To include carbon sequestration in the estimation of the CF, which will reduce the value of the total GHG emissions by 38.8% to 44.8%, depending on the functional unit used; and (ii) to quantify other services provided by the farms and make the correct allocation to each of them, as suggested by Ripoll-Bosch et al. [72]. Just like in farms producing both meat and milk these products are allocated their share of GHG emissions, which is calculated according to their economic value [40], in pastoral goat farms like the ones here studied, the regulating and cultural ES provided should also be economically valued and allocated their share of the GHG emissions generated by the production system.

Another challenge for the sustainability of the current agrifood model is the high use of non-renewable energy sources despite the actual threat of oil depletion [73], and the pollution associated with them. From this point of view, low-input pastoral goat farms have several advantages. In contrast to intensive models, the practices implemented in grazing systems translate into important reductions in the use of non-renewable energy, because this type of energy is mainly related to the production and transportation of feed concentrates. Pérez-Neira et al. [74] made a comparative analysis of various pastoral dairy goat farms in the Sierra de Cádiz (Andalusia, Spain), and revealed the potential environmental benefits derived from land-based stockbreeding, and more specifically, grazing activities. Those benefits include gains in energy efficiency, reduction of dependence on non-renewable energy, and avoidance of the environmental costs associated with the use of energy in other types of grazing systems. In addition, the low consumption of animal health and phytosanitary products completes the picture of low dependence on external inputs in these farms, thus, confirming that grazing is an effective, nearly carbon-neutral, and therefore, cost-effective, non-toxic and non-polluting weed control technique [67].

Even though traditional meat-producing systems have a high degree of feed autonomy, which is one of their strengths, it is also true that the area devoted to growing crops for animal feed should be moderately increased when the circumstances allow it. This would provide a supplement for the animals in times of natural pasture shortage, which would, in turn, have an effect on the above-mentioned low productivity rates.

4.1.3. Cultural Services

Access to a pleasant environment and to leisure activities is another service offered by the farms monitored in this study. Many cultural services are associated with traditional agriculture landscape, and there is strong evidence that their biodiversity plays a positive role in enhancing human well-being, especially in the case of agro-tourism, eco-tourism and educational activities inspired by the local ecosystems and taking place in the landscape [75].

Despite the negative effects that the pressure of tourism may have on the primary sector in certain mountain areas, some subsectors have made the most of the implementation of this kind of activities. The FAO [76] has argued that a holistic approach to food production in protected areas is required to achieve a successful integration of agriculture, livestock husbandry and ecosystem conservation. This idea underlines the importance of cultural landscapes within protected areas as food suppliers playing a significant role in food security [26]. In Andalusia, for instance, the so-called "oil tourism" is an opportunity to explain the true relevance of olive oil and to create a channel for economic diversification in rural areas [77]. Extensive goat production has enough ecological, cultural, heritage-related and gastronomical relevance to justify the development of this kind of activities. However, none of the farms analyzed receives any income from visits or tourist activities, a situation that should be corrected by introducing such activities into the agro-tourism circuits.

4.2. Proposals for Acknowledgement and Valuation of the Ecosystem Services Associated with Pastoral Goat Farming

Despite the multiple ES provided by goat pastoral farms, few of them are a source of income for farmers. The main remunerated service is related to the provision, more specifically to the supply of goat meat. However, as mentioned before, the income derived from the sale of kids does not in any way cover the costs of production. In order to revert this situation, it would be necessary to undertake certain actions connected to: (i) The differentiation, via labelling and information, of pasture-based products; and (ii) further research on the possible functional quality of meat produced in grazing systems, as well as on the development of traceability systems to guarantee authenticity. In other words, more research applied to the sector is required, a limiting factor identified in the structural analysis within the power zone.

The creation of a specific brand for pasture-raised goat products would contribute to enhance pastoral farming systems and could be the basis for a differentiated payment that would cover the costs of production, bringing the weight at slaughter closer to the required profitability threshold. Presently, there is no Protected Geographical Indication (PGI) for kid meat and only a regional quality brand has been registered, although a national regulation on the marketing of products from autochthonous animal breeds has already been passed [78], and implemented to various degrees.

The lack of acknowledgement of the environmental and cultural services provided by pastoral goat farms is a problem located within the power zone and one of the three major limiting factors highlighted by the consulted experts. Indeed, those services have no economic compensation, with one exception: The payment to farmers for using their animals to prevent forest fires. In Andalusia, a grazed fuelbreak network called RAPCA (Red de Áreas Pasto-Cortafuegos de Andalucía) was created in 2005, and two years later, it began remunerating farmers for the environmental services provided for the prevention of forest fires [79,80]. This network prioritizes the use of autochthonous sheep and goat flocks, well-adapted to the landscape and guided by shepherds, to overgraze certain areas under supervision, mainly firebreaks and the surrounding areas, thus, contributing to the selective and controlled reduction of the accumulated combustible biomass and the prevention of fires. This service, which entails an extra effort, is remunerated, and therefore, encourages participation. According to Ruiz-Mirazo et al. [79], the grazing service contract offered to shepherds usually comprises several firebreaks, which are priced 42 to 90 € ha^{-1} $year^{-1}$ in proportion to the estimated grazing difficulty. According to the data provided by Mena et al. [80], the payment for firebreak grazing was 8.60 € $animal^{-1}$. This payment for the provision of a specific ES should be extended to more livestock farms that are already actively participating in the prevention of forest fires in Andalusia, thus, increasing the area protected.

Even though progress has been made in recognition of regulating and cultural ecosystem services, little has been achieved in relation to the remuneration of the farmers' work and investment. Some authors like Baylis et al. [81] have argued that EU agri-environmental policies (AEPs) are examples of payments for environmental services intended to reduce the negative externalities of agricultural production, while transferring public funds to farmers. In this sense, Ripoll-Bosch et al. [72] have established, for sheep farms, a relationship between the agri-environmental aid of the Common Agricultural Policy (CAP) and the value of certain ecosystem services, but they have also underlined the difficulties in establishing such relationship, because the amount subsidized is based on political decisions and the loss of agricultural production rather than on empirical observations for valuing cultural ES. They also insist that the variability of subsidies among regions and countries could be the result of arbitrary political decisions rather than of production as such.

According to Gouriveau et al. [82], CAP aid is defined within a complex and restrictive political and regulatory framework. They were mainly designed to address the environmental problems faced by intensive farms, whereas, the design and implementation of policies responding to the needs of extensive livestock farms were given much less weight. It was expected that, after the last reform of the CAP, land-based livestock husbandry would be given some special attention, but the way the reform has been implemented in Spain has hindered the redistribution of aid from the First Pillar, negatively affecting extensive livestock systems [83]. This has been brought to light by the structural analysis performed in the present study, with the experts consulted underlining the inadequate design of CAP aid and the bureaucracy associated with it (both problems are included within the power zone). Regardless of the design of the aid, the difficulties in meeting environmental commitments and the corresponding penalties, as well as the lack of regularity in the reception of those aids, are serious problems, classified into the exit zone by the experts.

Some authors, such as Pulina et al. [20], have argued that EU agrifood and agri-environmental policies favor those systems that are better integrated with the environment, but they also admit that the grazing livestock population is drastically decreasing in Spain. Other authors consider that EU policies have damaged small-ruminant pastoral husbandry in Spain, because the direct payment system applied since 2006 has been detrimental for local Spanish farmers and not for their colleagues in other EU countries [83]. An example of this is the restrictive application of the coefficient of admissibility of pastures in Andalusia, which reduces the area that is, in fact, eligible for the reception of CAP aid [83], and affects goats more intensely than other ruminants, because they are usually raised in mountain areas.

It is then possible to ask whether European aid (56% of the income of the farms analyzed) is indeed designed as a payment for the provision of certain ES. The payments for environmental and climate services included in the Second Pillar of the CAP have an unquestionable environmental objective, because they pursue the maintenance of activities that are beneficial for the environment in order to avoid the risk of abandonment, and encourage the introduction of production systems that allow a more sustainable use of the natural resources. However, it is not possible to affirm that these aids actually remunerate the provision of ES because the calculation is based on other elements. Thus, the aid for the maintenance of endangered native breeds aims at compensating the loss of profit associated with the lower yields of this activity compared to those of more commercial production alternatives. In addition, the design of those payments has proved to be detrimental for meat goat breeds, which receive a lower amount per animal than meat sheep breeds. As for the aid intended for the maintenance of organic agriculture and livestock husbandry practices and methods, it aims at compensating the additional costs of meeting the commitments concerning the transition to organic production systems, as well as the differences in production. These subsidies contribute to the development of management systems that may involve the provision of certain services, but they do not pay for the services as such, thus, opening a relevant debate around the challenge of monetizing those other services supplied by livestock-rearing systems [47].

Finally, it is necessary to emphasize that the direct payments included in the First Pillar of the CAP have a different spirit and objectives. In Spain, there is a subsidy for goat-rearing initiatives that aims at guaranteeing the economic viability of the farms and reducing the risk of abandonment [84]. This aid is 25.8% higher for farms located in mountain areas or islands (8.83 € animal^{-1}, compared to 7.02 € animal^{-1} for farms in other types of areas), which, however, do not need to be grazing-based.

The European HNV-Link project, which has analyzed the CAP support policies and measures [82], has pointed that, even though certain aspects of the CAP have positively evolved and measures, such as the direct support to areas facing natural or other specific constraints (ANCs), the agri-environmental and climate measures (AECMs), and the payments related to the operation of the Natura 2000 network and the creation of Operational Groups (OG) has been developed, other steps are still missing. The CAP must provide the degree of protection that extensive livestock farming demands, through both the First Pillar (via direct payments and fairer eco-schemes) and the Second Pillar (via specific and well-resourced agri-environmental measures). In this model, the new basic payment would, thus, be intended to compensate the farmers' loss of income; eco-schemes would incentivize the ecosystem services already provided by pastoralism; and agri-environmental measures would encourage the development of additional practices, which are essential for the global sustainability of grazing livestock farms [85].

The decline in traditional livestock practices can be observed in worldwide, in special in European mountain areas, with large implications for the sustainability of grazing agro-ecosystems [86,87], so that future policy measures must pay more attention to local characteristics and needs that could help develop future scenarios to address imminent challenges in ecosystem service provide.

5. Conclusions

This work, which is the first assessment study of the sustainability of meat-oriented autochthonous goat farming and its impact on human wellbeing, has been carried out in a context characterized by the risk of disappearance of the activity in Andalusia. The traditional systems associated with the Blanca Serrana and the Negra Serrana breeds should not be linked exclusively to the production of meat, because this is not the only service they provide. These pastoral models create a framework, in this case, an agroecosystem, which favors the provision of services that benefit people and are mainly environmental, but also social, cultural or heritage-related. These services are neither properly acknowledged, nor valued or quantified, and are therefore, excluded from commercial circuits and political decision-making processes, a situation that creates an enormous competitive disadvantage. In order to revert this situation, it is essential to acknowledge those breeds and the farms where they are raised as "producers of high functional quality meat and ecosystem services", so that those services they provide to society can be socially acknowledged and economically valued.

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